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(54) Coil for deflection yoke assembly, apparatus, and method for making the same.

(57) The present application is concerned with coils for deflection yoke assemblies wherein changes in the homogeneity of the coil windings are created to obtain a desired magnetic field pattern for deflecting electron beams in cathode ray tubes.

The control of the distribution of the wire in the winding may cause damage to the windings during manufacture.

This drawback is avoided by means of dimples or depressions formed in a deflection coil for a CRT deflection yoke assembly by inserting a spherically shaped end (100) of a dowel-like pin (98) through a hole (102) in the wall of a female arbor (80), to protrude into a winding cavity (90) formed between a male arbor (82) and the female arbor (80) of the associated yoke coil winding machine. The pin end is inserted only partially into the cavity (90), for acting as a deformation in the wall of the female arbor (80), thereby causing convolutions of wire being wound around the cavity to overly the pin (98).

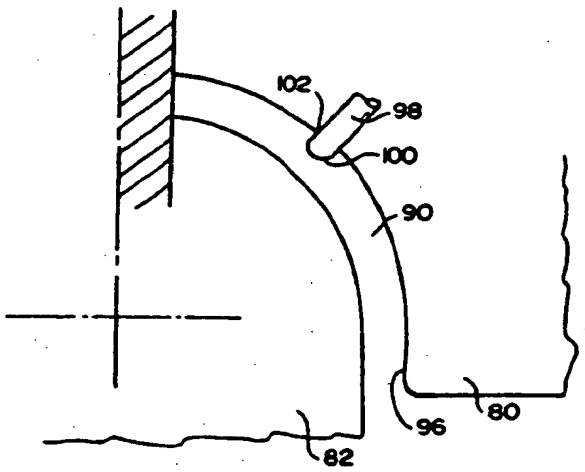

FIG. 9

EP 0 470 315 A1

The field of the present invention relates generally to deflection coils for tel vision or similar systems, and more particularly to deflection coils including physical interruptions or changes in the homogeneity of the coil windings for producing a desired magnetic field pattern when current is allowed to flow through the windings, and a method for making the same.

Background of The Invention

In television and other typical cathode ray tube (CRT) based systems, deflection yoke assemblies including deflection coil windings are mounted on the back outer cone and stem of the CRT. In one typical application, the deflection yoke assembly may include a pair of opposing saddle coil deflection windings proximate the CRT, that is in the inn rmost portion of the yoke assembly relative to th CRT. The outside portion of the yoke assembly may in a typical application have opposing toroidal windings or deflection coils. In such a typical application, the saddle coils may be driven by the horizontal deflection circuit of a television system, and the toroidal coils driven by the vertical deflection circuitry, for positioning an electron beam at any particular instant in time on the face of the display screen of the CRT. In other typical applications saddle coil windings may also be driven by th vertical deflection circuitry. Other combinations f saddle and toroidal deflection coil windings may be used, depending upon the particular application.

In order to produce the required electromagn tic fields via the flow of current through the deflection coils of the deflection yoke assembly, th windings must be accurately positioned. By way of illustration of the present invention, saddle coil deflection windings are particularly described. A conventional method of manufacturing saddle coils, for example, is to wind the coils in a cavity created between male and female arbors. As is known in the art, the male and female arbors may be held stationery with a flyer mechanism rotating thereabout for winding enamel coated copper wire, for example, within the cavity to form the deflection winding. Contrariwise, the arbors may be rotated, in association with a stationery wire feed mechanism. During the winding process various techniques are used in order to control the distribution of the wire in th winding for obtaining a desired electromagn tic field pattern.

One known apparatus and method for winding a deflection yoke coil is disclosed in Gross et al. U.S. Patent 3,518,590, entitled "Deflection Yok And Apparatus For Its Fabrication Utilizing A Magn tic Ramming Technique", issued on June 30, 1970. A deflection coil is fabricated on apparatus including a pair of male and female members for providing a cavity therebetween when mated together, with a window block extending between the members for dividing the cavity into identical compartments. A plurality of convolutions of wire are wound into the compartments within the cavity for forming a desired coil configuration.

Ishikawa U.S. Patent 3,912,182, entitled "Apparatus For Winding Saddle-Shaped Deflection Coil", also teaches the use of male and female members that when mated form a cavity therebetween. The deflection coil is wound within the cavity for providing a desired winding configuration for the deflection coil. The male and female members are designed to have particular cross sections at any given point in order to provide the desired winding configuration for the saddle-shaped deflection coil.

Summary of The invention

An inventive feature of the invention is to provide both an improved deflection yoke coil winding, and an improved apparatus and method for making the same. Still another object of the invention is to provide an improved apparatus and method for making a deflection yoke coil in a manner substantially reducing damage to the windings during manufacture.

With the problems of the prior art in mind, these and other objects of the invention are provided by selectively positioning protrusion means to penetrate into one or more areas within a cavity formed between male and female members of a deflection coil winding apparatus, during the winding of a coil in the cavity, for introducing dimples or depressions into preselected locations on the winding portions, for obtaining a desired shaping of the electromagnetic field produced by the coil when current is passed therethrough. In one embodiment of the invention the protrusion means projects from the surface of the female member into the cavity in a manner for causing the desired dimple or depression to be formed into the deflection coil as it is being wound, in a manner avoiding penetration of the protrusion means through the windings, and at the same time avoiding damage to the enamel of the windings and associated wire proximate the protrusion means.

Brief Description of The Drawings

Various embodiments of the present invention are described below with reference to the accompanying drawings, wherein like items are identified by the same r f r nce designation, in which:

Fig. 1 is a perspective view looking from the front right of a typical prior art d flection yoke assembly.

Fig. 2 is a side view of the prior art deflection yoke assembly of Fig. 1, showing the same as installed on the rear portion of a cathode ray tube (CRT).

Fig. 3 is a cross sectional view of a typical prior deflection coil system mounted upon a CRT, shown in simplified form.

Fig. 4 shows a representative deflection coil produced by apparatus of the present invention.

Fig. 5 shows a deflection coil including an embodiment of the invention, as fabricated using a method of the present invention for forming dimples or depressions on selected areas of the surface of the deflection coil winding.

Fig. 6 is a cross sectional view taken on the line 6-6 of Fig. 5, showing typical central portions of the dimples or depressions formed into the deflection coil winding surface by a method of the present invention.

Fig. 7 is a simplified perspective view of a female member or arbor of the apparatus of the present invention, showing a technique for producing spaces or openings at selective locations through the surface of the deflection coil winding as it is being wound.

Fig. 8 shows a simplified perspective view of a male member or arbor of the apparatus of the present invention.

Fig. 9 shows a simplified partial cross sectional view of the apparatus associated with a method of the invention for producing a deflection winding with dimples or depressions at predetermined locations on the winding.

Fig. 10 is a simplified perspective view of a female arbor of one embodiment of the invention, including a hole for permitting a pin or dowel-like rod having a spherically shaped end to protrude into the coil winding portion of the arbor, for providing the apparatus and method for one embodiment of the invention.

Fig. 11 shows the female arbor of Fig. 10 with a deflection coil winding wound within the arbor, using the method of the present invention for producing a dimple or depression at a predetermined location on the surface of the deflection coil winding.

Detailed Description of The Invention

With reference to Fig. 1, a typical deflection yoke assembly 2 includes a forwardmost bezel 4, an inner shell member 6 upon which opposing and substantially identical deflection coils or windings 8 and 10 are mounted. As shown, the deflection coils or windings 8 and 10 are comprised of a plurality of turns of relatively small diam ter copper wire, that is typically enam l coated, and wound into a predetermined configuration. An outer shell 12 of the truncated cone-like yoke assembly 2 typically has mounted thereon two opposing outer deflection coils or windings 14 and 16. In conventional practice, the primary or main portions of deflection windings or coils 8 and 10 lie in quadrants that are different from and orthogonal to the quadrants containing the outer deflection coils or windings 14 or 16, as shown. The more narrow rearmost portion of the cone shaped portion of the yoke assembly shell terminates to a stub-like cylindrical section 18, upon which is mounted a locking band 20, in this example.

In Fig. 2, the yoke assembly 2 of Fig. 1 is shown mounted on a cathode ray tube (CRT) 22 with the stem 24 of CRT 22 protruding from the rear cylindrical portion 18 of the yoke assembly housing, and terminating to a male connector 26. The locking band 20 is tightened via clamp screw 28 for securing the yoke assembly in position on the CRT 22. Also shown are typical convergence rings 30 and 32, which are rotated for aligning the paths of the electron beams to desired specifications. Note that the pictorial illustrations of Figs. 1 and 2, and other Figures herein are not to scale, and are included for purposes of illustration only.

In Fig. 3, a simplified cross-sectional drawing is shown for illustrating the positioning of deflection coils relative to a CRT 22. As shown, deflection windings 8 and 10 are formed in the shape of saddle coils or windings, whereas windings 14 and 16 are toroidal coils or windings, in this example. Also in this example, the toroidal windings 14 and 16 are wound around soft magnetic cores 34 and 36, respectively, in this example. Deflection coils 8 and 10 are driven by horizontal deflection circuit 38, and deflection coils or windings 14 and 16 are driven by vertical deflection circuit 40. An electron gun 42 is positioned within CRT 22 for emitting electron beams along the Z axis 44, to strike a luminescent screen 23. The electromagnetic fields produced by deflection coils or windings 8, 10, 14, and 16, respectively, cause the electron beams to be positioned at a desired spot on the screen 23 of the CRT 22, at any given instant of time.

In this illustration, the apparatus to be described below produces deflection coils or windings in the shape of saddles, as shown in Figs. 4 and 5. With further reference to Fig. 4, a saddle coil 46, that could be used as deflection coils 8 or 10, for example, includes front end turns 48, rear end turns 50, flared side members 52 and 54, front end turn apertures or openings 56 and 58, intermediate side apertures or openings 60 and 62, and rear end turn apertures or openings 64 and 66. Note that the apertures or openings 56, 58, 60, 62, 64, and 66, are of a predetermined size and shape, and are purposely located at th positions shown, in this example, for providing partial control over the

shape of the electromagnetic field produced by the saddle winding or coil 46 in different regions thereof, for correcting various errors that would otherwise occur in the positioning of the beams. For example, the field produced in an entrance region 68 is controlled for correcting coma errors that may occur in this region. The field produced in an intermediate region 70 is controlled for correcting convergence errors. The field produced in the exit region 72 is controlled for correcting geometry errors that occur at the edges of the picture produced on the screen 23 of the CRT 22. Also note that ach side member 52 and 54 in this example is a mirror image of the other, with associated apertures of one side being substantially identically duplicated on the other side.

In a preferred embodiment of the invention, the illustrated saddle coil 46 shown in Fig. 5 is substantially similar to that of Fig. 4. However, the apertures or openings 60 and 62 in the side members 52, 54, respectively, have been eliminated and replaced by dimples or depressions 76 and 78, respectively. Note that in this example the depressions 76 and 78 are diamond shaped, but could be otherwise shaped depending upon the application and lectromagnetic field shape required in the int rmediate region. In this example, dimples or depr ssions 76 and 78 are mirror images of one anoth r, and are positioned opposite to one anoth r.

In Fig. 6, a cross section of saddle winding 74 is taken along line 6-6 of Fig. 5, as shown in Fig. 6. The deflection coil winding 74 is fabricated in such a way, as will be described below, to provide that the provision of dimples or depressions 76 and 78 does not cause unnecessary crowding or stress on th underlying wires.

Illustrated saddle windings 46 and 74 of Figs. 4 and 5, respectively, were in this example made using a conventional saddle coil winding machine, with arbors modified in accordance with the inventive teachings.

An embodiment of a female arbor according to the invention is a female arbor 80, as shown in Fig. 7. A male arbor 82 is shown in Fig. 8. The arbors 80 and 82 are mated together with a threaded locating screw 84 of male arbor 82 being inserted through a locating hole 86 in an arbor pedestal 88 associated with the female arbor 80, as shown in this example. A nut, not shown in the drawing, is threaded on screw 84 tight against the back of arbor 80. Pedestal 88 fits into a corresponding shaped cavity 88a in mal arbor 82. When so mated, a cavity 90 is formed between the male and female arbors 80 and 82, respectively, as shown simplistically in Fig. 9. In a conventional manner, a flyer (not shown) is used to wrap wire around and within the cavity 90 between the stationery arbors 80 and 82 to form the saddle windings 46 and 74, for example. The various apertures or through holes, as previously described for saddle coils 46 and 74, are each formed during the winding process by inserting a pin 92 typically having a relatively pointed tip 94 through a hole 102 (see Fig. 10) in the landing platform or inside bottom portion 96 of female arbor 80. The landing platform portion 96 receives the wires as they are being wound about the arbors 80 and 82 for forming one of the saddle coils 46 or 74 of this example. As shown in Fig. 7, the pin 92 is made to protrude substantially across the cavity 90 (see Fig. 9) between the male and female arbors 82, 80, respectively, as the wire is being wound. Typically, the diameter and overall shape of the pin 92, and its angle of entry into the cavity 90 determines the size and shape of the aperture 94 formed at that location in the deflection coil being fabricated. A number of such pins 92 may be utilized for forming apertures at various positions, as desired, in the manufacture of a deflection coil.

The use of pins, such as pin 92 projecting through holes in the inside wall 96 of an arbor 80, provides a means during the winding of the deflection coil to more precisely distribute the wires during the winding process. As indicated above, the use of such pins 92 creates apertures or holes through the deflection coil being wound, while at the same time permitting better control of the position of the associated wires. However it has also been found that when such pins are employed in winding a deflection coil to control the distribution of wires in the middle of the arbors (also in the middle of the deflection coil), that the associated apertures or holes cause a major change in the winding distribution and pattern of the associated electromagnetic field produced by the completed deflection coil. Many times, the associated changes are greater than desired, and difficult to control. Also, it has been found that the pins 92 sometimes damage the wire being wound in an associated arbor. Enamel damage may occur during winding of the deflection coil, or in a heating/pressing cycle, during which cycle the arbors are pressed together using conventional techniques to complete formation of the deflection winding. Deflection coils wound as saddle coils are particularly susceptible to wire and/or enamel damage from the use of pins 92, for example.

With reference to Figs. 9, 10, and 11, in an embodiment of th invention, a pin 98 having a less pointed or spherically shaped head or tip 100 is inserted through a hole 102 in the platform portion 96 of the female arbor 80 in a manner for causing a depression or dimple, such as 76 and/or 78 of Fig. 5, in the d flection coil being wound. As shown in Fig. 10, the inside bottom portion 96 of

arbor 80 may have a number of through holes 102 at desired locations for permitting pins 98 or pins 92 to be inserted through the holes 102 from the other side of the associated arbor wall, whereby th extent of protrusion of pins into the cavity 90 is controlled for either producing apertures with pins 92, as previously described, or dimples or depressions in the deflection winding in a manner to be described below.

The pins 98 permit control over the distribution of the wires being wound in the cavity for forming a deflection coil, while avoiding the wire and enamel damage sometimes caused through the use of the pins 92 for forming apertures. To create a dimple or depression in the deflection coil winding, for controlling the wire distribution at a given location in the deflection coil while it is being wound, the pin or pins 98 to be utilized are initially retracted for the first winding turn or layer of a deflection coil 104 (see Fig. II) to be wound on the landing platform or inside wall 96 of arbor 80. Depending on th application, the pin 98 may remain retracted for more than a first turn, wherein the winding apparatus is programmed to cause pin 98 to partially insert at least the spherical head 100 of pin 98 into a desired region where the deflection coil 104 is being wound. The turns necessary to complete the winding or coil 104 are then completed. Note that by so inserting a pin 98 partially into the winding r gion of arbor 80 or cavity 90, the pin 98 is equivalent to causing a deformation to be formed within the cavity 90, that is on the inside wall 96 of arbor 80, during the winding process. In a typical application, one or more pins 98 having a radius ranging from 5.0 millimeters to 6.0 millimeters, with spherical ends 100 thereof of larger radius, provide the forming of diamond shaped dimples or depressions 106, as shown in Fig. 11.

The design of the pins 98, with spherical ends or heads 100, along with the programmed partial insertion thereof into the cavity 90, is accomplished in a manner providing for a soft contact between the end of the pin and the wires being wound over and about the pin 98, or pins 98 at different locations. In this manner, one or more dimples or depressions 106 can be formed into a deflection c il winding 104 during the winding of the wires thereof, as illustrated in this example. However, if the pins 98 are made to protrude far enough into cavity 90, they could cause an aperture to be formed instead of a depression or dimple in the winding. In the illustrated embodiment, the pins 98 are made to protrude in such a manner that their spherical tips 100 provide a soft contact therebetween with the wire being wound into the deflection coil, as previously m ntioned. Such soft contact, r sulting from control of the extent of the insertion of pin 98 into cavity 90, and the spherical shape of the pin end 100 substantially eliminates any damag to the wire or the enamel on th wire during the deflection coil winding process. This illustrated embodiment of the invention is particularly applicable in the winding of saddle coils.

In the areas including the dimples or depressions 106, the wires of the deflection coil winding 104 are of lesser density than in other areas of the deflection coil 104, thereby providing control over the shaping of the electromagnetic field produced by the deflection coil 104 when current is passed therethrough. The previously illustrated apertures or voids can be used to accomplish a similar result. However, as previously mentioned, much more precise control is provided over such ultimate field shaping through the use of the dimples or depressions 106, rather than through the use of the aforesaid apertures. However, in certain applications it may be advantageous to utilize a combination of apertures, such as 56, 58, 64, and 66, in combination with dimples or depressions such as 76 and 78, as shown in Fig. 5.

Note also that during the winding of a deflection coil 104, the apparatus can be programmed for variably changing the positioning of one or more pins 98 in the winding path, for obtaining a desired distribution of wires about such pins 98, rather than inserting the pins 98 from a retractive position to a fixed position within the winding path, for example. Also, a combination of pins 98 and pins 92 may be used in other applications, in the manner previously illustrated, for forming both apertures and dimples or depressions at predetermined locations on the outside portions of side members of deflection coil windings, such as 104, during the fabrication process.

In Fig. 11, a female arbor 80 is shown with a substantially completed deflection coil winding 104 having a dimple or depression 106 formed at a desired location in the flared side portion 108 of the deflection coil 104. In this manner, control of the distribution of the wires throughout the deflection coil 104 can be obtained, and particularly for the intermediate side portions thereof.

Although various embodiments of the present invention have been shown and described herein, they are not meant to be limiting. Many other advantages and variations of the present embodiments of the invention may become apparent to those of skill in the art, wherein such variations or alternative embodiments are meant to be protected by the spirit and scope of the appended claims. For example, instead of selectively inserting one or more pins 98 through holes 102 in the insid bottom portion 96 of the female arbor 80, for creating dimples or depressions in the d flection coil winding during its fabrication, permanent deformations can be f rmed in the inside bottom portion 96

to accomplish the sam result. Interchangeable inside bottom portions 96 with different patterns of deformations could be provided to accommodate making different configurations of deflection coils 104, for example. The pins could also be introduced in male arbor 82 so as to create dimples in the interior contour of the coil winding.

Claims

1. A deflection yoke coil of a deflection yoke assembly for a cathode ray tube (CRT), comprising:

   a plurality of convolutions of wire formed into a shape having opposing side members with a window opening therebetween, said coil including front end turns and rear end turns, each wound in a direction generally transverse to said side members; characterized in that

   at least one depression or dimple (76,78) of predetermined shape being formed in an int rmediate region (70) of each one of said side members (52,54), for controlling the distribution of said wire proximate said depressions (76,78).

2. Th deflection yoke coil of Claim 1, characterized by

   at least one front end aperture (56,58) being formed through each one of said side members (52,54) proximate associated front nd turns (48), respectively.

3. Th deflection yoke coil of Claim 1 or Claim 2, characterized by

   at least one rear end aperture (64,66) being formed through each one of said side m mbers (52,54) proximate associated rear nd turns (50), respectively.

4. The deflection yoke coil of Claim 1, characterized in that said side members (52,54) are outwardly flaring from said rear end turns (50) toward said front end turns (48).

5. The deflection yoke coil of Claim 1, characterized in that each one of said depressions (76,78) in said side members (52,54) opposes a like positioned and shaped depression in the other of said side members.

6. A saddle-shaped coil for a deflection yoke ass mbly for a cathode ray tube (CRT) having a substantially cylindrical neck section housing an electron gun at one end, and flaring outward sections from the other end of said neck section to terminate at a frontmost luminescent screen, said screen being substantially perpendicular to the longitudinal axis of said CRT, said deflection coil comprising:

   a plurality of convolutions of wire, each convolution including a side member disposed on opposite longitudinal sides of a window opening of said coil, and extending generally longitudinally of said tube while substantially conforming to said cylindrical neck and flared sections of said CRT, and front end turns and rear end turns extending generally transversely of said CRT in connecting said longitudinal side members, said side members being concave and flaring outward from said rear end turns to said front end turns; characterized in that

   said side members (52,54) each include a plurality of opposing dimples or depressions (76,78) in wire portions away from said CRT (22), said depressions (76,78) in one of said side members each opposing a like positioned and shaped depression in the other side members of said coil (46).

7. The saddle coil of Claim 6, characterized by a plurality of rear end turn apertures (64,66) and front end turn apertures (56,58) through each one of said side members (52,54) proximate said rear and front ends of said coil (46), respectively, said apertures through one side member opposing a substantially similarly shaped and located aperture through the other side member.

8. A method for forming dimples and apertures in a deflection coil for a deflection yoke assembly, for controlling the wiring distribution thereof while making said deflection coil via apparatus including a female arbor, a male arbor that mates with said female arbor to create a cavity of predetermined shape in which said coil is wound from a plurality of convolutions of wire, said female arbor having an inside surface forming a wall of said cavity upon which said convolutions of wire overlay, characterized in that said wall (96) has a plurality of holes (107) at predetermined positions underlying where said coil (104) is wound, said method comprising the steps of:

   providing a first pin (98) with a dowel-like body of a first radius, and a generally spherical end (100) of second radius;

   winding at least one turn or layer of wire in said cavity;

   forming a deformation in said cavity via partial insertion of said pin (98) through a preselected hole (102) in said wall of said female arbor (80), whereby the nd of said pin (98) protrudes a predetermined distance into

said cavity; and

winding additional layers or convolutions of wire into said cavity for completing said deflection coil (104), said pin (98) causing a particular wire distribution thereabout, and depression or dimple (106) in said deflection coil winding about the area overlying said pin (98).

9. The method of Claim 8, characterized by the step, before said winding step, of inserting a second pin (98) having a relatively tapered head through a preselected hole (102) in said female arbor (80), whereby the head of said second pin (98) protrudes substantially into said cavity, for causing said wire to lay about the sides of said pin (98) as the deflection coil (104) is wound during said winding step, thereby causing an aperture to be formed in said deflection coil at the locations of said second pin (98).

10. Apparatus for making a deflection coil for a deflection yoke assembly for a cathode ray tube, said apparatus including female arbor, a male arbor that mates with said female arbor to create a cavity of predetermined shape in which said coil is wound from a plurality of convolutions of wire, said female arbor having an inside surface forming a wall of said cavity upon which said convolutions of wire overlay, characterized by

deformation means (98) protruding into said cavity (90) at a preselected location from the wall (96) of said female arbor (80) partially forming said cavity, for causing a dimple to be formed at said preselected location in said deflection coil (104), during the winding thereof, for controlling the distribution of said convolutions of wire forming said deflection coil (104).

11. The apparatus of Claim 10, characterized in that said deformation means includes:

a hole (102) through said wall (96) of said female arbor (80) at said preselected location; and

a first pin (92) having a dowel-like body of a first radius, and a spherical end (100) of a second radius, said first pin being inserted through said hole through said female arbor wall (96) to have its head end protrude into said cavity a distanc necessary at said first pin location for causing a desired siz and shape of dimple to be formed in said deflection coil proximat said first pin.

12. The apparatus of Claim 11, charact rized in that the second radius of each first pin is greater than the first radius th reof.

13. The apparatus of Claim 11, characterized in that said pin (92) has a relatively tapered end (94), the tapered end of said pin causing an aperture to be formed through said deflection coil (104) at said pin location, during the winding of said deflection coil in said cavity (90).

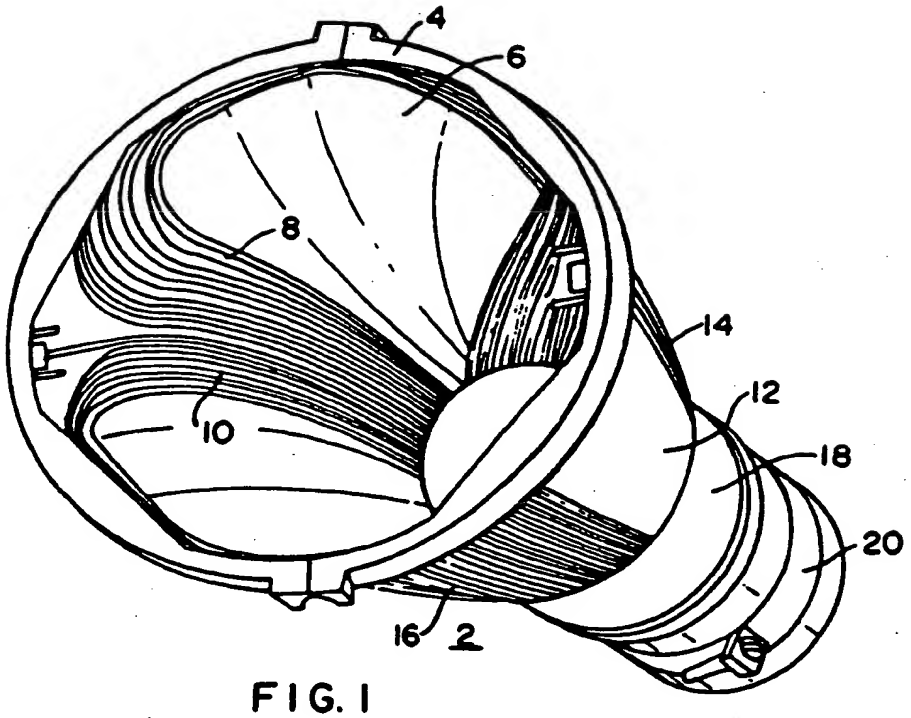

FIG. 1

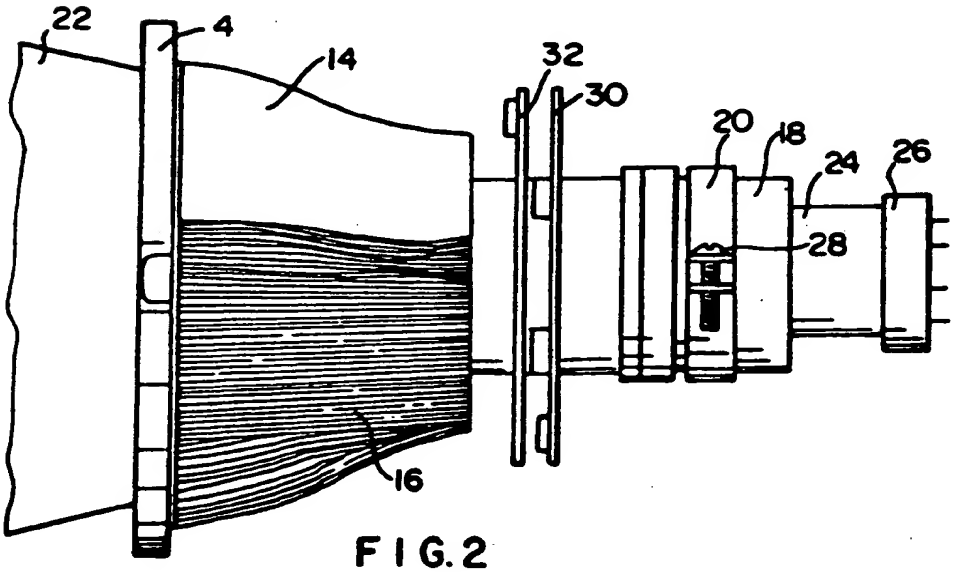

FIG. 2

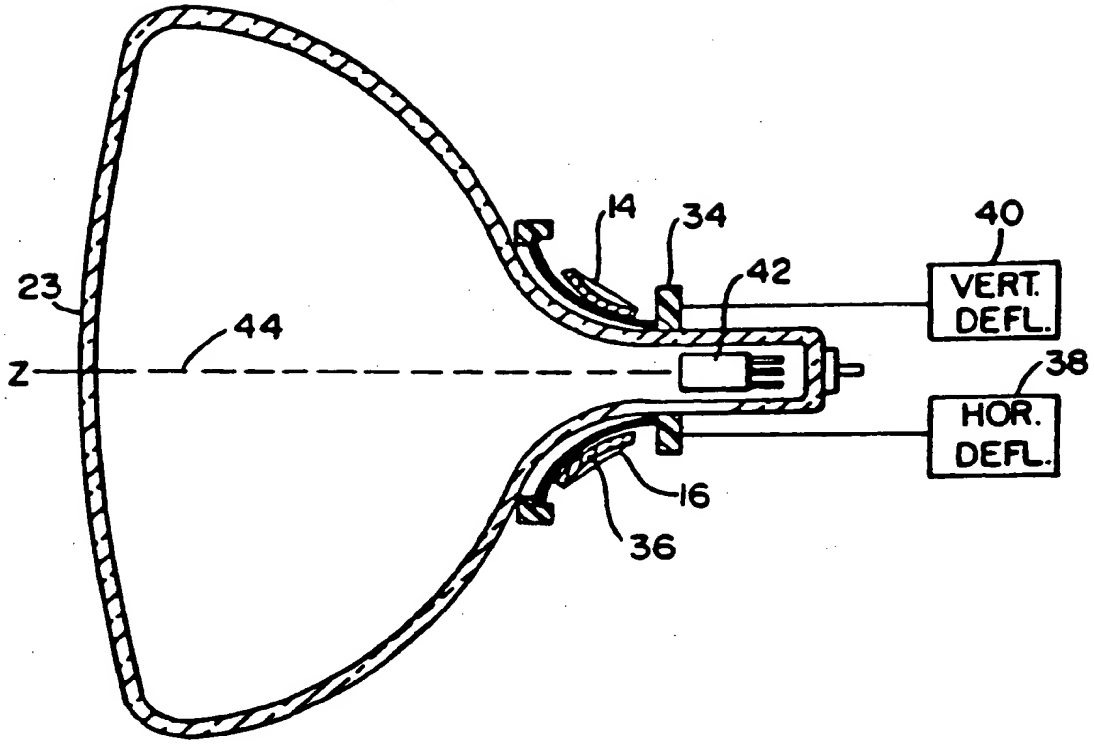

FIG. 3

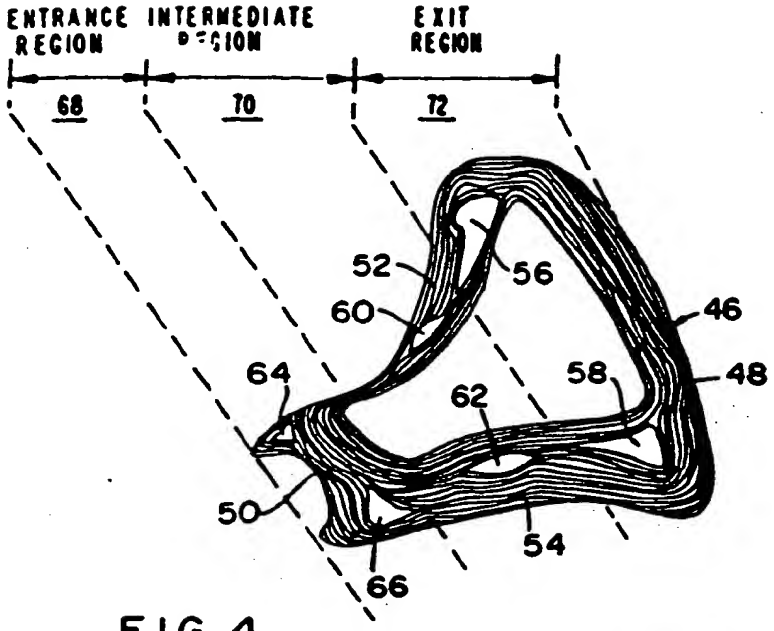

FIG. 4

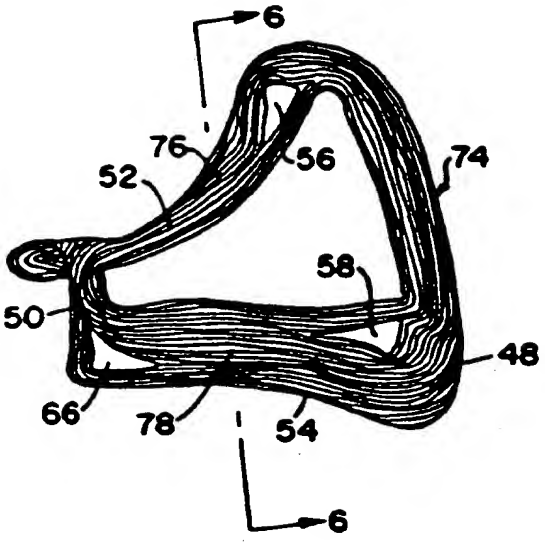

FIG. 5

FIG. 6

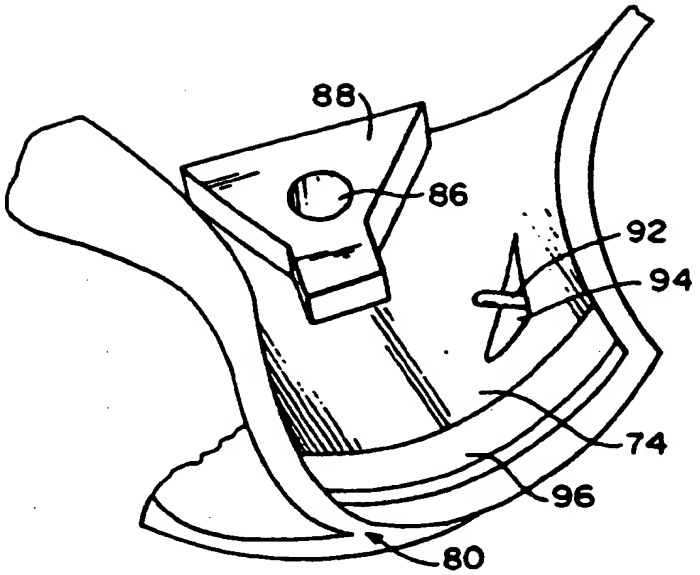

FIG. 7

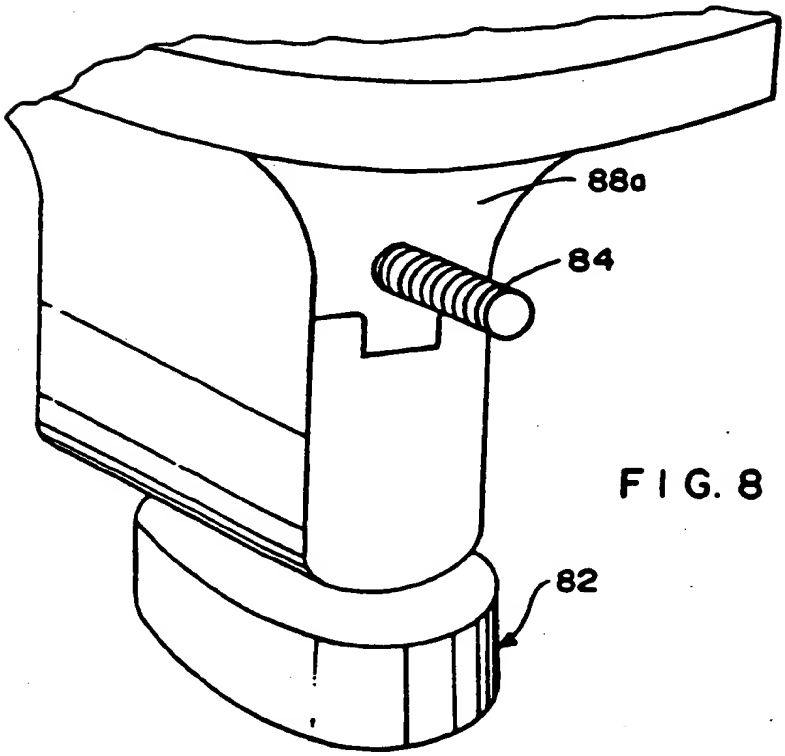

FIG. 8

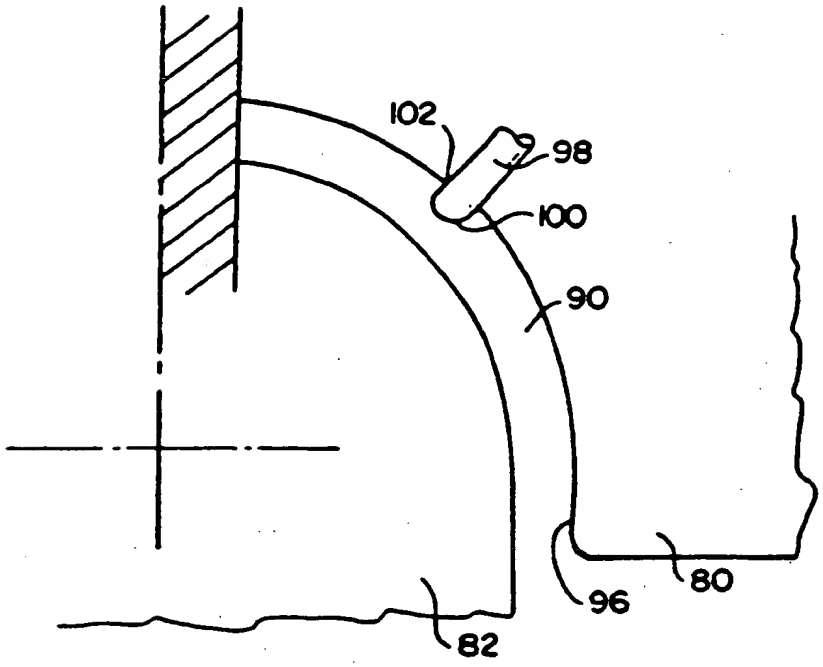

FIG. 9

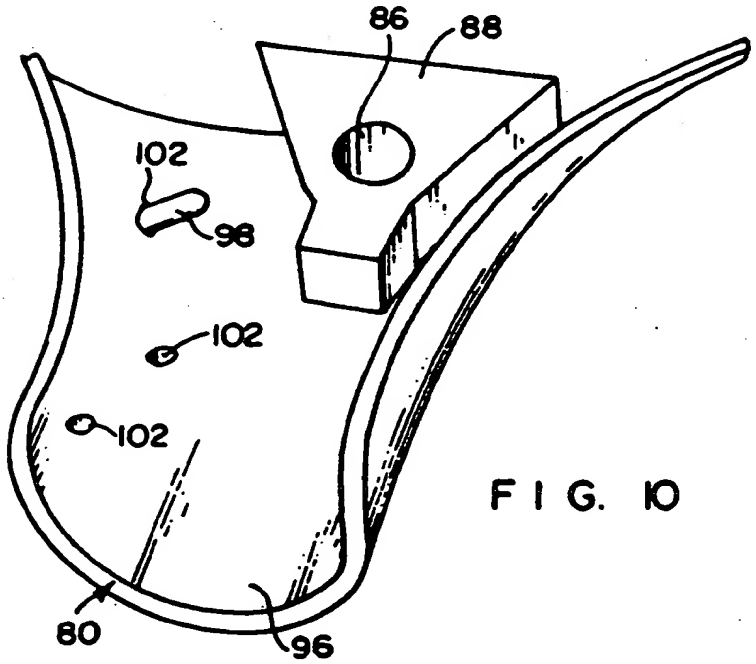

FIG. 10

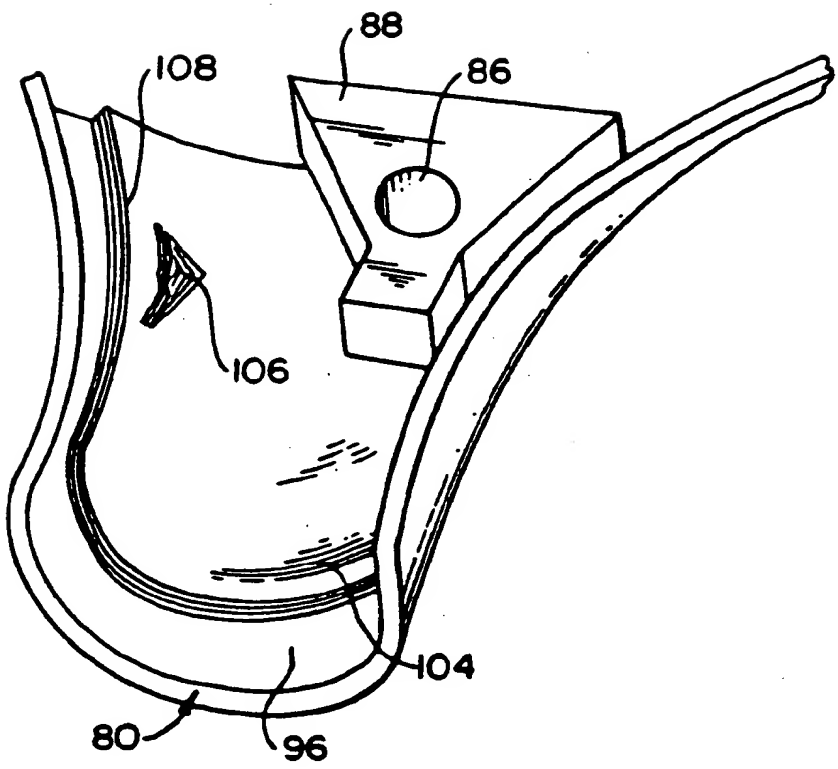

FIG. 11

Eur pean Patent Offic

EUROPEAN SEARCH REPORT

Application Number

EP 90 40 2261

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-4 228 414 (A.V. BAUZHIS et al.) * Figure 3; column 1, line 58 - column 2, line 5; column 2, line 35 - column 3, line 11 *	1-4,7-10	H 01 J 29/76 H 01 J 9/236
Y	US-A-3 968 566 (R. SCHUBERT) * Abstract; figures 3,5; column 2, line 67 - column 4, line 1 *	1-4,7-10	
Y	EP-A-0 366 196 (N.V. PHILIPS' GLOEILAMPEN-FABRIEKEN) * Figures 2,3,5; column 4, line 22 - column 6, line 25 *	1-4,7	
A	US-A-3 855 694 (M.C. VAN DER HEIJDE) * Abstract; figures 1-3; column 2, line 26 - column 4, line 2 *	1-13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 J

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	07 March 91	CLARKE N.S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same catagory
A : technological background
O : non-written disclosure
P : intermediate document
T : theory or principle underlying the invention

E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document